Journal of the American Foundrymen's Association.

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A FOUNDER'S TRADE SCHOOL.

The Iron Trade Review, July 25. Mr. Thos. D. West says that to-day a different class of men are required for managers and foremen of our important foundries than was the case 10 or 15 years ago. The general advancement of the foundry art to the high plane it occupies to-day, with its intricate, difficult and scientific operations, make it essential to train men who are thoroughly experienced molders. Even if to-day the many specialty shops could get along without a knowledge of all of the branches of founding, it were much better if they pursued such a general knowledge for the good of the trade at large. This knowledge would help the managers of the specialty shops to still further economize in their operations. Moreover, they would be better equipped to judge a new device or method on its merits. The same knowledge would also be invaluable in judging whether certain branches of the trade required more skill than others, this in connection with labor disputes. Very few foundries realize that practically everyone in the trade suffers more or less from a lack of knowledge of some portion of his industry. Usually it is the lack of facilities and possibly opportunity which accounts for this. For this reason several of our colleges have instituted courses in foundry work with the idea of giving their students at least an idea of the requirements they must meet in life later on. While this is, of course, well enough in its way for the man who is to manage a plant from the office, the direct responsibility will fall upon the man in actual charge of the production of castings. Mr. West has hoped to

find the new Carnegie Technical School follow out the ideas he advocates for the benefit of the molder-foundryman, but after a personal visit to look over the ground with the committee in charge, concluded that the old lines would be followed, and the good he hoped to see accomplished would not materialize. Mr. West objects to our present college curriculum as landing a man into a shop, without practical experience, in middle life, whereas it should fit him to take a position worth from 2,000 to 10,000 dollars a year at the age of 24. The kind of trade school Mr. West would like to see established should treat molding, mixing metals, and cupola work. Experience should be imparted the student in green sand, dry sand and loam work, and light, machinery, and heavy castings should be made which are best calculated to afford this experience. Four years of 9 to 10 hours daily with the students advancing rapidly from one class of work to the next should be equivalent to some 6 to 12 years of work in the ordinary shop. The evenings should be given over to the study of the theory of founding, embracing the metallurgy of cast iron and steel, drawing, machine design, book-keeping, etc. In the three last months the student is to act as assistant to the general foundry manager and get into touch with methods of management. This one point alone would justify the entire institution. While the successful manager is born, not made, yet contact with really successful men is a great help in molding character. The question of course comes up, how can such a school be established? Mr. West was requested by the American Foundrymen's Association to look into this matter and report at the next convention. He proposes, moreover, to push the matter to a successful issue with the help of those most interested. Mr. West now outlines the plan which, if fully carried out, would put the school on a good paying basis from the start, and expects to make a full report of the whole matter at our next convention.

The Tradesman, Sept. 1. Mr. E. H. Putnam discusses the foundry school with his accustomed vigor. After tracing Mr. West's career as a foundryman, and emphasizing his eminent fitness to undertake just such an important work, he dilates upon the real need of a foundry school for the trade of this country. The very best place to apply the remedy for our ills

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is in the position of the foundry manager. Get him thoroughly posted and the rest will follow for his works. That the qualifications of such a manager are expected to be quite varied, that his experience must be very broad goes without saying, and Mr. Putnam rightly states that one of the most embarrassing things to ask of a successful man is to recommend another for a given vacancy. We can all recommend good molders, but a good manager is quite another matter. Mr. Putnam points out that the present process of training our foundry managers is a slow one, one which is often made very hard by jealousy, human nature having to be reckoned with very strongly. Then again while the graduate of the shop can and generally will turn out a very valuable man, the advantages of a good four years training in a school as Mr. West would have it, are so far superior to the long drawn out process now existing, that it is to be welcomed as of extreme value. Now look at the molder of to-day. Not one in several hundred has any knowledge of cupola practice, and yet this is indispensible to a well equipped founder. It looks easy enough to the man who knows how, but let the other man try it. How about core making? Here again Mr. West's school would give thorough instruction. In fact the narrow specialization of the trades to-day would be no factor in this undertaking so far as imparting knowledge is concerned. The management of the business requires special qualifications that few foundry employees think of. There is the owner pulling one way and the workingman the other. This habit grows on the latter, and often the foreman walks out on a strike with the men simply as a matter of habit. Were this foreman well trained in the broad principles of foundry management, this would not occur. Mr. Putnam, therefore, strongly advocates Mr. West's idea and hopes for a speedy consummation of his plan.

MACHINE CAST FOUNDRY PIG IRON.

The Iron Trade Review, Sept. 12th. Mr. A. L. Colby, of the Bethlehem Steel Co., delivered an interesting address before the Foundrymen's Association of Philadelphia recently, in

which he first defines the so-called sandless pig iron and describes the ordinary method of running out a blast furnace tap into sand. The difficulties of the furnace, together with the severity of the work upon the men, make the casting machine a desirable feature here, even if there were no other value received elsewhere. An interesting account of the origin and development of this form of casting pig iron is now given, and then Mr. Colby takes up the advantages of the sandless pig. To the maker of basic steel the machine cast pig need not be emphasized, in fact where pig iron is used the machine cast is always called for and sand pig is accepted only at a reduced price. This is on account of the attack upon the lining taking place when sand is introduced into the basic open hearth furnace. The machine cast pig melting quicker, the reactions are shortened and steel is made quicker. The same thing holds good for the puddling process. We foundrymen are, of course, interested in the application of this form of pig iron to our own industry. In the matter of weights the founder could get the full 2,240 lbs. of iron per ton of sandless pig, instead of the 2,268 or 2,256 lbs. in the so-called "sand ton." The shorter the distance between furnace and foundry, the more the sand on the pig iron. In any case the disputes arising in adjusting the payments are exceedingly annoying. In melting machine-made pig iron much less slag is produced, in fact less limestone need be charged in the first place. The chemical composition of the pigs is more nearly alike, and there is a greater uniformity in the pig itself. This is because the iron is tapped into 20 ton ladles, and has a chance to mix well before it is cast into pigs. These solidify more quickly and hence segregation is not so apt to take place toward the top and center of each pig. The objections which foundrymen have to sandless pig iron are four in number. First, the prejudice against it dating from previous sales of misfit basic pig irons for foundry purposes. Second, the large size of the pigs. Third, the close grained fracture, and fourth, the difficulty in drilling for analysis. Regarding the prejudice existing against machine-cast pig iron on account of former lots which proved successful, this is perfectly correct, but the makers of a good material should not be condemned therefor. The size of some pigs may be too large for foundry work, but there are

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makers whose pigs weigh only 90 lbs. apiece, and if the question is pressed other people will make pigs of proper size and weight also. The main stumbling block to the introduction of machine-cast pig iron into the foundry is its appearance. The foundryman is afraid of the fracture. That this iron, though close grained, if it has only the right chemical composition, will make just as soft castings as sand-cast pigs of like constitution, has been repeatedly proven by actual trial, and Mr. Colby gives a number of facts appertaining thereto. True, the combined portion of the carbon being raised in the pig, its fracture shows a much closer structure, but this is only due to the more rapid cooling due to the chilling action of the pig mold. A parallel case is found in the great use of chilled car wheels as scrap in mixtures for making soft castings. The chill does not appear in the result of the melt either. Another way to meet the objection of foundrymen is to show them the misleading features of sand pig fracture indications. Mr. Church's book is quoted in which nine different brands of a No. 1 Northern coke pig gave silicon from 1.75 to 3.44 per cent. Nineteen different brands of No. 2 Southern coke pig gave silicon from 1.73 to 3.79 per cent. How can regular results be expected from these irons when buying by grade? It has been claimed by many users of machine-cast pig irons that the fracture of these is a safer guide than in the case of sand pig irons. Mr. Colby advises us not to rely on this, for every maker has a different method of casting and size of pig. He asks us to hold to chemical analysis in every case and go by that, being careful to watch total carbon also in the case of very soft castings. Mr. Colby now emphasizes the necessity of good sampling in the fracture and sale of pig iron. The furnaceman must consider each cast as a unit, and obtain a sample of the true average of the cast. To do this he should take 4 to 6 samples from the ladles while emptying into the molds. The metal is shotted by dropping into water and the same number of shot from each sample pounded together, and thus a true sample for analysis obtained. The sampling of the cars of iron by the buyer should consist in taking two pigs from the surface of the car, one from each end, and two from the bottom, each pig being representative of a given section, then drilling into the broken fracture of the pig with a large drill. Where machine-

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cast pig iron is used and the metal cannot be touched with a drill at all, it must be pounded up in a steel mortar. Mr. Colby concludes his highly interesting article by urging the rapid introduction of sandless pig iron, not only as doing away with the uncertainties of buying by fracture, but as establishing a true basis upon which to buy and sell iron, the price varying only with the constituents.

MACHINE MOLDING.

Cassier's Magazine. Mr. Joseph Horner traces the development of machine molding in England and America, showing that although the molding machine was in use over 40 years ago in England, yet a single American firm will use more machines in its shops than will be found in an entire English district. In comparing machine with hand molding, the first saving effected is the doing away with the match, then the cutting of the gates, and finally the simplifying of rapping and withdrawal of the pattern. To offset this, of course, comes the greater first cost of the machine equipment. The tendency of the cheaper molding machines is to adapt them for wooden patterns so that if only a few castings are made, the expense of iron patterns is avoided. Mr. Horner describes the mounting of patterns on the machines and says that the mistake is often made in thinking that it does not pay to mount them where only a few castings are required. It is something like turret lathe work, in which daily routine soon diminishes the cost of preparation. It often pays to mount patterns on a machine for only a dozen castings once the men are skilled at it. Mr. Horner now discusses hand versus power ramming, allowing that the latter is only useful for work in which there is no difficulty on the score of uneven packing of the sand. Some of the most successful machines ignore power ramming altogether, and are content with the advantages derived from pattern mounting and withdrawal. In vibrating machines the difficulty is that the motion is not only communicated to the pattern but also to the sand, with all the

trouble that results therefrom. Hence the stripping plate gives us the best results. The shape of the pattern, however, will determine whether a stripping plate is necessary. Attention is called to the desirability of portable molding machines. Here again the size of the work will determine this feature. Heavy machines cannot be moved, and hence the flasks must come to them. This means conveying systems which in turn are regulated by the method of pouring used in the foundry. Mr. Horner sums up his experience in the following: For the average work of our larger foundries, portable machines of the hand rammed stripping plate type should be installed. In certain cases only will fixed power rammed machines be preferable. The machines now in the market will give ample selection, and new ones are constantly being offered, so that eventually more work will be done by machines than by hand.

REMEDY FOR STRIKES.

American Machinist, Aug. 15th. Charles Francis Adams, the well known authority on Social Economy, has written a letter in which he suggests the appointment of strike commissions which will put the public in full possession of the facts of each case being fought out. In this way the misrepresentation continually going on, according to the prejudices aroused, may be done away with, and logical deduction made by the public, who generally suffer from the effects. A crystallization of public sentiment inevitably takes place, and usually in favor of the right side, which tends to force the settlement on lines fair to both parties. Much is written about compulsory arbitration as a means to stop conflicts between capital and labor. So far, however, there is no way to have a decree issued by the tribunal respected and obeyed. Were the employer and employed only interested in the matter, they might safely be left to fight it out, but in these days of immense consolidation, the public is really the defenseless sufferer. Mr. Adams relates a long forgotten incident on the Boston & Maine R. R., where a strike was declared

and annoyed the traveling public as well as shut down all trade intercourse for a few days. Then the State Board took a hand in the matter, called the parties of both parts before it, heard the evidence, and made a full report of the facts public, adding certain recommendations of its own to obviate further trouble and to help in the adjustment of the matters at issue. The effect of this public announcement was immediate, public sentiment was rapidly formed and pressure came so effectively that the strike was settled very quickly. This experience, Mr. Adams suggests, should be utilized in the formation of arbitration boards whose deliberations could be quasi judicial. Only unprejudiced men should be appointed, and the deliberations made public property. The recommendations could not be enforced, it is true, but this would not be necessary, in view of the moral weight of an aroused public opinion. All ends of "compulsory arbitration" would be served. Where facts, undisputed and clearly proven, are presented, and reasonable recommendations are made, the false pride which stands in the way of nine settlements out of ten would be removed, and a way to recede gracefully provided. What was good in Massachusetts in 1877 is good now, so far as the principle involved is at stake, and even if a public ventilation of the differences existing should not result in an agreement, it will at least do no harm.

THE BABY BESSEMER PROCESS IN THE FOUNDRY.

Eisenzeitung, Oct. 3. Mr. Carl Rott delivered a lecture on the above subject before the German Foundrymen's Association which convened recently in Dresden. He states that the Bessemerizing of small quantities of metal at a time is now attracting universal attention in Europe, not only for steel, but for malleable and even gray iron casting. As the two last mentioned applications are entirely new to us over here, they will no doubt be of interest. It seems that the main difficulty with all forms of the process is the retention of enough heat after the completion of the "blow" to hold the metal sufficiently fluid for

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casting purposes. Williamson, of Scotland, has combined a gas producer with the converter so that gas is burned over the bath while it is being held pending disposal. Mr. Rott uses an apparatus which blows in charcoal dust, and thus gets the necessary heat. He describes his apparatus at length. For many years it has been the custom in England to reduce the silicon and carbon in pig irons by Bessermerizing them partially, casting into pigs and selling this product to malleable works. Even Germany bought a lot of this material, especially for the Westphalian districts. It is now proposed to make castings directly out of the Baby Bessemer converter for malleableizing in the annealing oven. In fact this is already done in England in a small way. It is well to remember, however, that the malleable casting of America differs considerably from that of Europe. They call our castings "black heart," for in their own case the annealing process is continued long enough to practically decarbonize the entire piece. We, over here, think nothing of a casting two inches thick, which, when of the proper composition, and cast in chills, makes very good "malleable." Were the product of the Bessemer converter cast into similar sections, it would have to be in reality a steel to be of any account. With the converter metal of the same composition as our ordinary malleable, it is to be feared that the annealing process would not turn out "black heart" casting, but be rather like a poor grade of cupola iron. It will be interesting to note developments over in Germany on the above lines, for it seems possible over there to blow ordinary foundry irons for making fine gray iron castings, a proceeding which would be too expensive over here.

RELATIVE HARDNESS OF AMERICAN AND EUROPEAN CAST IRONS.

American Machinist, Oct. 3. Contrary to the general understanding in America, European cast irons have been found to be no harder than ours. This on the testimony of a young Ameri-

can who has had occasion to study the subject for the last two years in England and on the Continent. He declares that he has worked cast iron all over Europe and found it exactly the same as ours; it was tooled the same way and with the same material. Evidently the causes for the impression we have formed are now no longer active, and in dealing with European trade problems it would be well for us to remember this fact.

ARBITRATION VERSUS CONFERENCE.

American Machinist, Aug. 8. In reviewing a recent paper by Mr. Castle on the subject, this journal says that it did not realize that there were so many objections to arbitration as were shown in the paper in question. The chief trouble seems to be that boards of arbitration seek to compromise difficulties instead of meeting them on a square basis of simple justice. In their awards one party is given one-half of what it asks, the other one-half what it deserves. The peculiar feature of most boards is the position of the odd man in them. The other two really become the attorneys of the two sides, and he is practically the referee. Instead of, therefore, being a board of justice it is practically a court in which each side tries to win its verdict, and the odd man of the three is really the arbitrator. As an agreement is always expected, any number of grievances are brought up in the hope that one party will win something. In the case, however, where no odd man, or outsider to the two parties at issue, is called in, a disagreement means a fight, and both parties will hesitate long before calling a conference, knowing that the effect may be a serious one, and it is this "conference" method (the one used by the above trades) which the *American Machinist* thinks the best one to follow in cases of industrial disagreement and trouble.

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FOUNDRY APPRENTICESHIP.

The Iron Trade Review, May 16. A discussion of the apprenticeship question by the members of the Pittsburg Foundrymen's Association brought out some interesting points. It seems that with an apprenticeship term of four years the ratio of one apprentice to eight molders would make the theoretical life of the latter 32 years for active service. As a matter of fact this period of usefulness is only 20 years, at least in the machinery trade; so that to keep the supply of molders undiminished the ratio ought to be revised to one-fifth, and this would not then take care of the natural growth of the foundry industry either. It is quite probable that if the molders were given the facts and statistics of the case the antagonism now existing to more apprentices would disappear to a great extent. The stove manufacturers of America find that the active life of their molders is from 14 to 16 years only, and that the ratio of apprentices to molders in their shops (averaging the union and non-union) is 1 to 6. Even the Molders' Union Journal confesses that as the above trade is practically controlled by union labor, the present ratio of apprentices to molders is entirely inadequate to supply the demands of the future. The same trouble is found in the machinery trade foundries, but here the molding machine is solving the difficulty of finding enough skilled molders for the work to be done.

PATCHING ENAMELED SURFACES.

Wiener Metallerbeiter gives the following method of patching up defective places in the enamelled lining of bath tubs, etc.: Five parts colorless copal, 5 parts colorless dammar, are mixed and melted in a suitable pot. Stir in carefully 4 parts of Venetian turpentine. Care should be taken to keep the heat as low as possible so that the rosins do not darken. Any color may now be added to give the shade desired. Use this cement warm, and, if possible, warm the object to be repaired also. After the cement has set, apply pummice stone and water to grind off any unevenness.

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A CRYSTALLINE SULPHIDE IN PIG IRON.

American Institute of Mining Engineers. Messrs. Blair and Shimer describe a sulphide of titanium which they separated from pig iron made of New Jersey ores. The very interesting process employed gave this material in the shape of brilliant yellow spangles of a crystalline structure. This compound would not have dissolved in the acids used in the ordinary evolution method of sulphur, and hence it is argued that only the oxidation method should be employed, which method gets all the sulphur present. In this the authors are correct, as even the carefully prepared samples of our Standardizing Bureau show that the oxidation method yields results .01 per cent. higher than the commonly used method by evolution. Foundrymen should, therefore, insist on their sulphur determinations being made by the method of oxidation.

EXPLOSIONS IN CUPOLAS.

The Ironmonger, Sept. 28th. An inspector of factories in India reports some curious instances of careless cupola charging. A hollow pump plunger was thus charged without being broken up previously. Results, severe injuries to all the men attending the cupola. Other cases of hollow sugar mill rollers meant the death of several men. If the precaution of drilling a small hole into the hollow pieces were taken, a chance would be given for the moisture within to get out before an explosion results. In another case three old cannon balls were to be melted up. One of the men noticing a small brass plug screwed in one of these investigated and found the balls to be loaded shells. We, over in America, can also tell of such accidents. Too great care cannot be taken with the use of scrap, and foundrymen should continually instruct their cupola traders to be on the lookout for suspicious specimens.

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SHOT IRON.

The Tradesman, Nov. 15th. Mr. Putnam holds that shot iron is always worth saving. Even to-day it commands a very good price. Once shot iron is extracted from the dump heap more generally it will be found in the regular market reports. It is not so long ago that the malleable people buried their annealed scrap, but to-day it holds a high value. No one cared to experiment with it then, but the enormous quantities accumulating soon made it expedient to find a use for this material. So also with shot iron. Hundreds of tons are now buried in the cupola dumps which should be in good castings. It must, of course, be used with proper precautions. The chemist will soon determine what these are, once the foundryman begins to save it. But even if not used, if only saved, a market will soon be found once there is the available supply, and this means a source of income to the foundry not now followed up.

CONCILIATION IN THE BRITISH IRON INDUSTRY

The Iron Trade Review, Nov. 7. The frequent strikes in the South Wales tin plate industry have given us the impression that the domination of trades unions is so great over there that everybody is more or less hampered. This is not the case, however, for the iron and steel trades, where in fact a very good system is in vogue; so much so that not a strike has occurred for many years. The great bulk of the trade, with the exception of the South Wales district, is in control of the Associated Iron & Steel Workers of Great Britain, an association which refers everything to arbitration and conciliation. On the part of the manufacturers they have to deal with the Wages Board, and the Board of Conciliation and Arbitration. The formation of our great American consolidations has given our workingmen a similar opportunity for direct communication with the heads of great industries. They have the "Mill Committee" over there, too, but it is not so objectionable. A grievance is thoroughly threshed out in meetings

and goes through several boards before it is presented to the works owners. In this way the personal element is reduced to a minimum and the Secretary of the Manufacturers has a chance to conciliate before official action is taken. The Workingmen's Association makes a specialty of taking care of the members in sick and death benefits. The system is not at all paternal, differing in this respect with the German policy, and should be looked into carefully by our manufacturers, as it is well adapted to our conditions, and will doubtless eventually be introduced into this country.

THE ENGINEER AND THE FOUNDRY.

The Iron Trade Review, Nov. 14. What the engineer had done for the foundry is discussed by Dr. Richard Moldenke. The engineer had been made least welcome in this branch of the iron industry. It is only by contrasting the old and the new that the remarkable advances are seen. Even where the engineer is not made use of directly his genius is recognized in the selection of machinery and devices gotten up by him. The old prejudice against the engineer is rapidly dying out everywhere, and eventually it will also disappear in the foundry. The foundry itself is taken up in detail, and the engineer's work traced out. First come the buildings with the necessary transportation equipment of cranes and elevators. Power transmission, also the conveying of iron, coke and sand. The work of the mechanical engineer in the designing of blowers, fans, tumbling barrels and grinding machinery. The metallurgical engineer has probably done most of all in connection with the revolution of the foundry industry, the study of the iron itself being now placed upon an intelligent basis. Modern cupola construction, the molding machine, pneumatic appliances, in fact a specialization in everything going to make up the foundry as a whole has experienced the touch of the technical man, and the best way to thank him is to use him still more.

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RETAINING SAMPLES IN THE BRASS FOUNDRY.

Mechanical World. Mr. Walter J. May discusses the retention of samples and test bars in the brass foundry. Where alloys are made in which color is important this should always be done. In fact these standard samples ought to be in duplicate, one set for the office, the other for the shop. It may be objected that keeping so many samples piles up a lot of metal uselessly, but the advantages obtained are so many, notably the fund of information available for the foreman, that this extra cost is a good investment. The colors will range from red to pale yellow, depending upon the relative amount of copper and zinc used in the mixture. When the same proportion of two metals is used the color will be so nearly the same, even where the intervals of casting are quite long, that only an expert could find a distinction. The same may be said of the simple bronzes. Test bars should show fractures and finished surfaces to be valuable, as the chemical composition may be all right, and yet the physical structure vary very considerably. Round bars 14" long and 0.8" diameter are recommended as best for all around purposes. For ductility tests only, a bar 12" long and ¼" square is most suitable. For color a piece 2" square by ⅜" thick when finished is excellent. A collection of this kind for brasses, bronzes, phosphor and manganese bronzes, is so interesting that a case for exhibition will be found handy. Well kept record books giving all the information possible about these alloys are, of course, essential.

DIRECT METAL FOR CASTINGS.

The Iron Trade Review, Nov. 21, gives some advance sheets from the work of Mr. Thos. D. West on the Metallurgy of Cast Iron. In the early days of founding all castings were made directly at the blast furnace. The uncertainties of this method of procedure gave rise to the cupola process to remelt pig iron for casting purposes. Had the furnace been managed then as

it is now, the direct process would be used much more than it is, and even now it is a question whether competition may not make the furnaces look more closely into the subject. One of the difficulties of the process is the occasional presence of "kish," which is very troublesome when in castings, as it weakens them, making cold short, and spongy places. This "kish" will form as long as the iron is fluid, and really renders it unfit for casting purposes. It is after all only an excess of carbon which is thrown off in the cooling process. Direct metal free from this trouble is really very good for some purposes, especially where the sulphur must be low, that being taken up in remelting being obviated. The iron is also very hot and hence keeps its fluidity very long. If the "receiver" were used to mix up the metals of several furnaces the "kish" problem might be overcome, but the chances for the loss of heat are also very great. For heavy castings this would not be serious. On the whole there is no reason why direct metal, in the light of our modern methods, should not obtain fair trial where standard articles such as pipes, etc., are to be made in quantity.

MANAGEMENT OF THE FOUNDRY CUPOLA.

The Ironmonger, Nov. 9. Mr. Robert Buchanan recently addressed the Staffordshire Iron & Steel Institute on the practical handling of the cupola. He claims that with 8 or 10 feet between the bottom and the charging door no advantage arises from a double row of tuyeres. He wants the cupola contracted in the region of the tuyeres to insure a better blast penetration. Where more than one row of tuyeres is used the first does the melting, the second delivers the iron faster and hotter, but the third row, if this is used, is of doubtful value, being rather hard on the lining and requiring a deep coke bed. The flame at the charging door indicates what is going on in the cupola. It should not be continuous through the last charge, otherwise it would indicate a waste of fuel. A white flame belching even out of the top indicates too little blast. It is possible that the gauge

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shows enough pressure, but there is very likely a scaffolding in the cupola. The generally accepted tuyere area is one-ninth that of the cupola. It is well to make this area larger, but to provide for the necessary reduction in the lining up. Where a receiver is used to catch the melted iron the tuyere can be as low down as 4 inches above the bottom. Where the iron is held in the cupola, a 24 inch shell apparatus should have the first row of tuyeres 2 feet above the bottom. Mr. Buchanan now states that a slag hole is too seldom seen on a cupola, which would indicate cleaner iron or poorer practice than we have. They make their bottoms 12 inches thick in Staffordshire. 12 oz. pressure is recommended, and in case of a tuyere bunging up the use of a poker to push back the obstruction and the introduction of small coke into the tuyere which melts away the obstruction very quickly. The use of a laboratory is strongly advocated to go hand in hand with the cupola to check its working properly as well as assist in mixing the iron. In charging, the fuel should be level with the tuyeres and then the first iron. With a bed kindled up to the tuyeres blowing may begin at once. Any fuel above the melting zone in making the bed is wasted. If the metal comes down slowly the coke beds are too heavy. In this case reduce them gradually and note results. Stop reducing at a point where the iron begins to get dull. For the last two charges it is advisable to reduce the blast pressure to one half, as the wastage is very heavy with full pressure. An average of nine analyses of cupola slag gave the following as some of the constituents: Iron 4.96 per cent.; sulphur, .27; phosphorus, .049; silica running 58 per cent.

INSPECTION OF PATTERN WORK.

American Machinist, Sept. 19. Mr. John M. Richardson tells us that in some shops this is thoroughly attended to, while in others no attention at all is paid to it. It certainly pays, however, to inspect patterns before going into the foundry, and saves many dollars there. Only a large shop can afford to have a spe-

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cial inspector. Usually the foreman of the pattern shop attends to this duty. The idea of this inspection is not to reduce the care of the workingmen, but to serve as an additional safeguard or check. Where a mistake has been made by one man, a second one going over the work is not likely to fall into the same error. The degree of precision which should guide the inspector in his measurements should be set by the purpose the pattern is to serve. Rough jobs can stand errors of 1-16" or even 1-8", but accurate work necessitates keeping within 1-64" or even less. After the inspection of the pattern and approval thereof the responsibility of the man at the bench should end, even if found incorrect afterwards. Mr. Richardson now describes the appliances which should be furnished the inspector to carry out his work properly and then gives a number of interesting incidents which show how the draftsman as well as the mechanical engineer can help the pattern maker in getting out and using his work to the best advantage.

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A CASTING BREAKER.

American Machinist, Oct. 3, gives a very neat drop arrangement for breaking up castings for scrap purposes. Fig. 1 shows

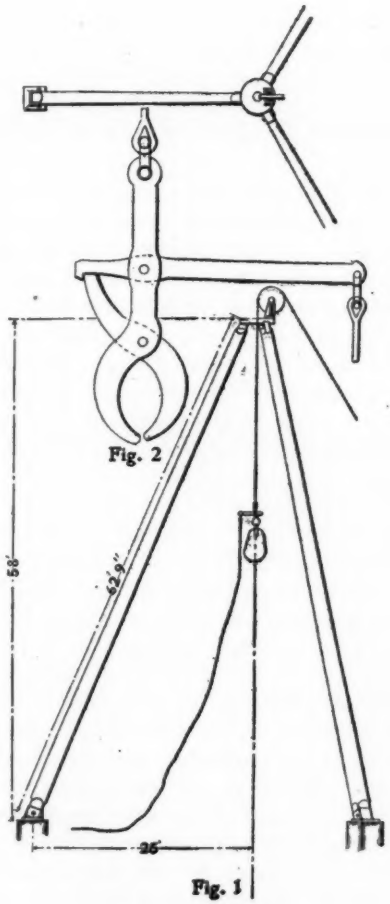

Fig. 2

Fig. 1

A CASTING BREAKER.

the tripod arrangement, consisting of wooden legs set upon cast iron feet. The weight is a 6,000 lb. egg-shaped ball and can be hoisted by power or hand. The latch hook, Fig. 2, is actuated by a rope hanging from the lever arm of the latch. The sizes and weights can naturally be changed to suit any required conditions.

SELLING PIG IRON BY FRACTURE.

The Iron Age, Oct. 3rd. In an important editorial this subject, so vital to foundry interests, is reviewed at length. It is predicted that the time will soon be here when selling pig iron by fracture will be so limited that no commercial importance need be attached to the practice. While everything in the line of foundry iron was sold by fracture not so long ago, no less than 75 per cent. of all sales are now being made under chemical specifications, according to the statement of large commission houses handling a general line of pig iron. The cause is to be found in the application of chemistry in the foundry. "From the time the raw materials are assembled at the blast furnace to the time when the resulting pig metal is converted into finished castings and rolled products, the oversight of the chemist has come to be almost universally demanded." In other branches, such as the Bessemer, the malleable Bessemer, and irons for steel making, all iron is now sold on chemical specification. Even the smaller foundryman is to-day specifying irons of the compositions he finds most suited to his work and herein the commission merchant is encouraging him, as it lessens the chances for complaint. Some foundrymen try to contract for chemical composition and fracture at the same time, which is a difficult thing to bring about, and will not prevail, yet the more the foundryman learns about the operation of the constituent parts of iron the more intelligently will he be able to make his purchases. In the issue of Oct. 17th, Mr. Seely B. Patterson writes an interesting letter on this subject, giving his own method of grading by analysis, and attempting to hold the fracture question in shape also.

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LEAD FOUNDING.

The Ironmonger, May 18, describes the casting of a large acid pot which weighed about 3,000 lbs. and was 2" thick. It was quite a job to cut up the old scrap lead pots into pieces which could be managed. This going too slow, a fire was built around them and the molten metal gathered up as it trickled out of the fire. While this was wasteful enough it was nothing to the loss of metal occasioned by charging the scrap and pig lead into the cupola after the iron had been run out for the day. The material melted so fast that it came out of the tapping hole in a continuous stream, and it was cherry red in color. The metal had to be held for over an hour before it could be poured and cold lead was added into the ladle in addition. The castings came out very fine—no blow holes, clean and tough. But the loss of lead was 1,500 lbs. out of 8,000 melted, which would go to show that the cupola as run in an iron foundry will not do for melting lead.

THE PROPERTIES OF STEEL CASTINGS.

Engineering, June 7, 14. Prof. Arnold took up the study of steel castings from a scientific standpoint some six years ago, and some of his results are given in a paper read before the Iron and Steel Institute. There were investigated the following correlations. The influence of chemical composition on the mechanical properties and microstructure, similarly the effect of annealing. Then the mechanical influence of variation in specific gravities. The influence of process, whether crucible or open hearth; of mass, whether the castings are small or large. The influence of heat treatment on annealed and unannealed castings. The influence of oil quenching. The influence of silicon and manganese on the carbons in connection with the recalescence point, and finally the properties of annealed castings after forging. In order to determine the best chemical composition for steel castings, specifications for high class material were studied and series of castings were made which embraced three distinct

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chemical groups. First nearly pure iron and carbon castings, everything else being kept low. Second, iron, carbon and silicon castings; everything else being low, and finally iron, carbon and manganese castings, everything else being low. The iron and carbon castings, which serve as a basis upon which to gauge the effects of silicon and manganese in the other groups, were made of crucible steel, and dry sand molds were used for the test bars. It was found that much of the trouble to reconcile results came from the initial casting temperature, and attention is called to the value of the pyrometer in determining the best temperature at which to cast steel. The series of tests made show very neatly the influence of increasing carbon on the tensile strength, sending it upward very decisively. On the other hand the effect of annealing, with the attendant increase in ductility, could be plainly seen by the microstructure, the crystals increasing in size. It was further found that the brittleness of unannealed bars was due to two causes; first, imperfect adhesion between the junction lines of the constituent masses, and second, from peculiar weak scoriacious layers running almost exclusively through the pure iron portions of the steel. These layers Prof. Arnold, as well as Mr. Stead, found to be a fusible metallic sulpho-silicide of iron, and fatal to the mechanical excellence of the castings. The peculiar thing about this is that small amounts of sulphur seem to promote the formation of this compound more readily than when large percentages are present. When the carbon reaches .55 per cent. there is a sudden drop in the ductility, in fact it is practically gone. The causes which affect the tensile strength of the steels experimented upon seem to be inoperative when the specimens were under compression. In annealing castings the heavy and light sections of the same piece give much trouble. It is, therefore, necessary, theoretically to soak such castings for days to get them evenly heated, the maximum temperature being about 1,750 degrees F. The practical summary is that iron and carbon only in steel castings do not give a sufficiently strong material to satisfy the demands of the trade, though they form the basis of all other work. Prof. Arnold promises the results from the silicon and manganese steels in the near future.

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IRON FOUNDERS OF THE PHILIPPINES.

American Manufacturer, page 707, 1901. Mr. G. D. Rice recounts some quaint experiences among the iron foundries in our new possessions. Only recently have casting methods been used there, everything being forged by hand. Where the Philippino owns a foundry it is neglected and there are but few appliances, but where American, German or English owners take hold, an improvement is at once visible. The question of the supply of iron is naturally most important, but although some pig iron is made from native ores, nearly everything used is in the nature of scrap. Sugar mill machinery, old wagon tires, etc., are selected by the Philippino in preference to good pig iron, and values are high. There is a great demand for castings now, as the methods of building are changing rapidly, and army and navy requirements are heavy. The turn-over is not as large as it should be, and hence good men will not go into the business readily. The foundries as a rule are crude, all work being done on the ground floor, bamboo being the mainstay of the buildings. Power is obtained from 2 to 6 horses by means of an ordinary traction device which, while not steady, seems to answer the purpose. Wind mills are also common. There is a good demand for foundry machinery, and American makes are giving the best satisfaction. Foreign makes are often deceptive, being second-hand material painted over again. Philippino labor gets 10 to 15 cents per day. The Chinese get only 8 to 10 cents per day. Spanish foremen are the rule, and they get $1.00 in gold daily. Superintendents may get as much as $3.00 daily. Fuel is plentiful, wood being the only kind used at present. Coal, however, is being mined now with good prospect of plenty of it. Finally our foundry supply houses are advised to open communication with the islands, as our machinery and supplies are in great demand there.

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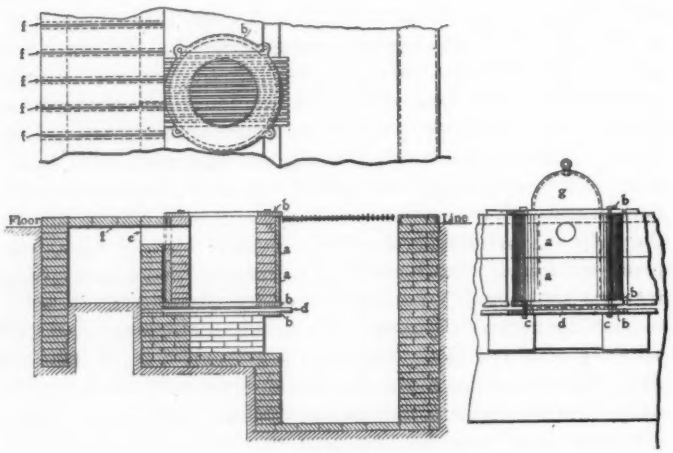
FITTING UP A BRASS FOUNDRY.

American Machinist, June 20. An anonymous writer describes his experience in designing and building a small brass foundry. Over the furnaces a trolley and chain was arranged to lift the crucibles and carry them to a clear space provided for skimming and making ready to pour off. The floor was well paved in order to save all the spilled metal each day. A good big water trough was provided in the middle of the shop which served the purpose of dipping the hot castings to get the proper color as well as to blow out the cores. The furnaces as shown in the accompanying cut are lined up with the fire brick with



BRASS FURNACES.

joints well made. The body consisted of two pulley rims *a* about 34 inches in diameter and 1 inch thick by 13 inches face. The top and two bottom plates *b* are of cast iron and are off the same pattern. Two bars *c* each 1½" thick separate the bottom plates, thus making space for the cast iron grate bars which are 1 inch square and 40 inches long. The small connecting flue *e* between the large flue and the furnace is of 6" pipe. A damper could be put in if desired. The large flue is intended for future additions

of furnaces. The top is supported by cast iron T rails. The stack is 20 inches in diameter by 40 feet high and draws well. The pipe is sewer connected so that no water may remain and be the cause of explosion if a pot breaks and the brass runs out. The stall system so much used in snap flask foundries was adopted, with the result that the work was easier for the molder and the sand was more uniform. Plenty of sand was on hand, and in two piles so that cold sand was always available for alternate heats. A cast iron trough was also provided to catch the drippings of brass when the molds are poured on end, and finally an iron crucible without a bottom was in use for taking care of the clippings of copper wire, etc., which were pounded in until the conical form was well filled. It was then turned around and the "ball" pushed out. This could then go into the brass melting crucibles without trouble.

INDUSTRIAL BETTERMENT.

Cassier's Magazine, June. Mr. H. F. J. Porter, the well-known representative of the Bethlehem Steel Co., discusses a subject upon which there are many opinions, and which run widely apart. In these days of somewhat altruistic tendencies many shop betterments have been introduced which would not have been thought of a few years ago. The reasons for doing this, and the results arising therefrom, are not so well understood. A careful study of actual conditions will often reveal the reason why great industrial corporations will not accede to demands of this kind, and wisely so. From the earliest times in the iron industry labor has been a disturbing factor. The old guilds kept the various processes secret and punishment with death awaited those who divulged family property of this nature. Progress was therefore only made in hand skill. Until science came along there was no general light diffused; the advent of technical men changed the several arts into industries based upon science. The guild opposed this tendency without avail, but introduced the strike. Lockouts followed, and unionism

finally developed and is strongly intrenched at the present day. It is a disgrace to the intelligence of the age that such barbaric warfare still exists. The broader teachings of religion all aim at an uplifting of our fellow man. Social science also trends that way, the method advocated being not in line of charity but to aid a man to help himself. Similarly each industry must work out its own methods of bettering the status of the men employed in it, even though handicapped by tradition and obstinate customs. In the iron and steel industry especially this holds true; work being paid for by its kind. Whether a man be good, or just passably fair, he gets the same money for doing the same work. Discontent follows this method of paying for labor. Despite this manifestly unfair custom, trades unionism is based on upholding it, and no advance is in sight for the specially good man if the union is allowed to prevail. With management becoming a science more and more, this cannot be tolerated if the best results are wanted. In other words we want the survival of the fittest ; the trades unions want as many as possible to survive. Why not get a combination of both? The best results are always obtained by paying for the best labor obtainable. An effort to obtain something for as little as possible always ends in trouble. A wise employer always tries to pay every man just what he is worth. He must establish a fair day's work for the normal man, and thus establish a wage rate which should not be deviated from. By this means a specially good man will get good money and the workman who falls below the average will eventually drop out and drift into occupations to which he is better suited. No favoritism should be allowed, and every man should feel that his work is steady and his wages sure. Beneficial associations should be encouraged, the employer furnishing more than half the dues, pensions for old age or disability being the features looked forward to eventually. Clerks should be made to feel like staying with a firm by receiving good salaries; in fact ambition and confidence should be aroused in the whole working force and the success of the enterprise is assured. Now come the suggestions for betterments in the establishments, and only now will they be of value. The management need not worry itself, as the ideas will be presented fast enough. Again when carried out they should not be advertised. A good thing will

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advertise itself sufficiently to attract good men, and they are what is wanted by every employer. The representatives of the trades unions would do well to study the general principles of industrial success in order to meet the employer on a common platform. Intelligence will win out in the end, and ignorance no longer has a standing against methods which are successful because scientifically true.

GRAPHITE CRUCIBLES.

Eisenzeitung, Nov. 28. Dr. M. Stoermer, of Berlin, contributes an article on this subject which must be interesting to our American foundrymen. The first statement he makes is that "some people have the queer idea that the expensive graphite crucible will gradually be replaced by other melting appliances. It is well known, however, that this wish is but father to the thought, as no one thinks of making good castings by any other than the crucible process, and the cupola is only good for an inferior product." How it would worry some of our European foundry writers if they were sent to this country to write up the crucible process as used in our foundries. According to Dr. Stoermer Germany now produces as good graphite crucibles as England, which would also seem strange, as for many years the finest German clays have gone to England and America for crucible purposes. These crucibles as now made are supposed to last 30 heats of brass and up to 20 of cast iron. What interests us most, however, is the discussion of the crucible itself. The use of graphite increases the resistance of the crucible to wear. The oxidation of the metal is decreased, the melting point of the crucible lowered, its conductivity greatly increased, pouring facilitated, and rapid changes in temperature robbed of their injurious consequences. It is of greatest importance to select the best grade of graphite for refractory purposes. The clay question is not so serious, according to Dr. Stoermer, wherein we differ with him here, especially for steel crucibles. Ceylon graphite is without question the best variety to use. It comes in lumps,

which are carefully ground and run over a magnet to separate out the magnetite. Careful sifting is necessary to get out the dust which contains most of the foreign matter. A very pure clay is necessary in crucible making, that of Klingenberg being preferred. The rational analysis of this clay gives us about 8.2 per cent. quartz, 5.4 per cent. feldspar, and 86.4 per cent. clay substance. Next comes the addition of quartz to the mass for crucibles. Of this grains 0.08 inches in diameter are used. In mixing up the batch the finely ground clay is treated with water, let stand 24 hours. In the meantime the graphite is weighed out, this being in various stages of fineness. About half of the quantity to be used is placed in the mixer, revolved a few times, and the clay then added. After running some time the balance of the graphite is added, and the whole material thoroughly kneaded for several hours. Any required water is added as desired and finally the granular quartz is added, after which the mixer is still made to run one hour. Now the finished mass is placed in cool damp vaults and let stand about a month in order to gain in plasticity. In large crucible works these batches are carefully numbered and worked up in regular order. When ready to take this up the clay mass goes into a sausage machine, the strings coming out being balled up and weighed out for the respective sizes of crucibles wanted. The plaster of paris forms are now filled and the potter's wheel used to get out the finished shapes. Now comes the drying of the crucible, which should be very slow, and finally the burning. A number of analyses of crucibles gave the following average: Silica 33 per cent.; alumina 12-13 per cent.; graphite 48-50 per cent., showing that the mixture must have been about 1,000 lbs. Klingenberg clay, 1,550 lbs. Ceylon graphite, and 375 lbs. crucible sand. About 10 per cent. of ground old crucibles can be safely added. Finally the necessity of strict supervision of the raw material is advised, otherwise the manufacturer who uses time honored recipes may suddenly find poor results when least expected, and—Dr. Stoermer quaintly adds—he has the laboratory at which this can be done.

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CHEMICAL--TECHNICAL LABORATORY.

Eisenzeitung, June 20, announces that in view of the urgent demand for information in the foundry circles of Germany it has established a chemical-technical laboratory which will take care of the interests of the trade in the line of pig iron and cast iron specifications, investigations, etc., the subscribers being entitled to special rates. While the enterprise thus shown may seem questionable, in the light of our American journalistic methods, yet it shows that the Germans are exceedingly quick to profit by our own experiences, and that while they are still melting iron in crucibles out there they may not be doing so very long, if America can teach them how.

VANADIUM.

The Tradesman, July 1. The probable effects of this rare metal upon the steel industry are discussed in "Kuhlau's" Journal. As it is recommended for use in roll mixtures it may be of interest to us. The metal itself is rare and expensive. The oxide, however, now taken from the slags of the Creus Steel Works, to the amount of 85 tons per annum, is used almost exclusively for dyeing black as well as ink making. Vanadium is alloyed with other metals such as aluminum, a bronze of 8 parts aluminum and 1 part vanadium, having a tensile strength of over 100,000 lbs. per square inch, and an elongation of 12¼ per cent. Ordinary wrought iron with 50,000 lbs. per square inch tensile strength was changed to 80,000 lbs. by the addition of 0.5 per cent. vanadium. A large supply of vanadium, when discovered, would, therefore, seem to open up new possibilities in the line of improving cast iron and steel.

TESTING CAST IRON.

Eisenzeitung, May 16th, notes that the German Foundrymen's Association is seriously taking up the question of standard methods of testing cast iron. The International Association for testing materials had left this point an open one in the drafting of its line of action, preferring to get more light on the subject before a final decision. This seems to have now been reached, and, quite possibly, at the instance of our Association, which first called attention to the desirability of classing cast iron by itself, no less than two years ago. The German Foundrymen's Association will now co-operate with the German section of the "International" to bring this matter up, Prof. Juengst being authorized to represent it, while we Americans are doing likewise, and have requested the Chairman of the American section, Prof. H. M. Howe, to look after our interests with the Executive Board. Your Secretary also, at the time of this writing, is on the way to Buda-Pesth specially to attend the convention which is to take this matter up.

MOLDING MACHINES.

The Tradesman, Oct. 1. Mr. E. H. Putnam has a little item on this subject. He advises that molding machines be used in their right place. Occasionally castings are made which cost more than if hand labor had been employed. As a rule, however, the error is on the other side. In the first place molding machines cost money, so that the man buying them will hesitate and investigate thoroughly. The more they will save, the more complicated and costly they are. In figuring the saving the element of time should not be left out. Thus for the same time your output may be doubled, as well as the cost per casting reduced one-half. The profit is, therefore, very much greater than is supposed. Naturally competition will cut down the selling price, but that is part of all business operations, and eternal vigilance is necessary to keep at the front of the procession.

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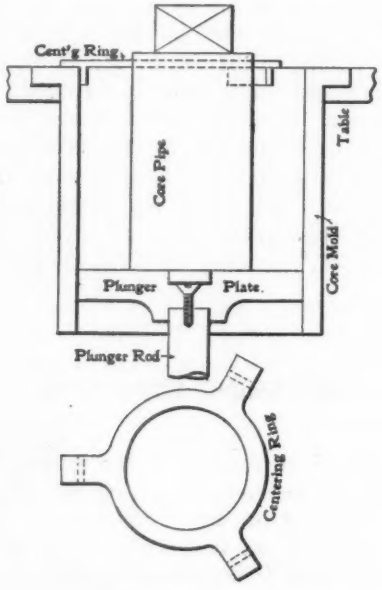
SOFT METAL CASTINGS.

American Machinist, Sept. 26. Where Britannia ware castings, or similar soft metals are to be made, the difficulty is always experienced that the mold will not be filled completely on account of the chilling of the metal. Mr. G. H. Brabrook has found that when stearic acid is added to the melted metal the difficulty is overcome. This is doubtless by the removal of oxidized products from the metal to be cast. The mold is made as usual. If plaster Paris or baked molding sand, the inner surfaces are impregnated with stearic acid by heating and applying the material. A single coat will do for several castings, a renewal, when needed, extending the life of the mold.

CENTERING CORE PIPES.

American Machinist, Aug. 29. Mr. Robert Grimshaw explains the European method of centering core pipes. The core mold has its flange at the upper end fastened temporarily to the table on which the core sand is piled. The plunger plate fitting snugly in the mold is attached to the plunger rod by a flask screw in the center. The core pipe is simply set on the plunger plate; its lower end being cut off square, the pipe is vertical if the plunger plate is horizontal. To ensure centrality, there is used a centering ring shown in the sketch, this being merely a flat ring with thee radial lugs, each of which has on its under side, at equal distance from the center, a downward projection or guide piece, which bears against the inner surface of the core-mold wall. This description of the centering piece applies to that used for a cylindrical core-mold; where the mold is square, elliptical, etc., in cross-section, the centering piece has a differ-

ent and corresponding orifice, and differently arranged arms and guide pieces. Where there are various sized core pipes used



CENTERING CORE PIPES.

for any mold, the centering ring for the larger pipes may be bushed for the smaller rings.

DIRECT METAL FOR CASTINGS.

Engineering & Mining Journal, Nov. 2. In the second part of a series of discussions on iron and steel making an "old contributor" takes the foundry severely to task. After sailing into that end of the foundry which has no use for modern methods very vigorously, he asks for the opportunity to build a "big mod-

ern foundry" for the U. S. Steel Corporation. Locating at Lake Erie, close to the Lorain Blast Furnaces, a 200 ton Jones mixer would be used to the exclusion of the cupola. To prevent undue cooling a regenerative apparatus would be provided, low phosphorus pig iron would be taken from the blast furnaces in big ladles. To reduce the silicon in the mixture ore would be added. Here we will stop a moment. First of all, why reduce the silicon contents? Melting in the cupola does this, and we we must, therefore, start with 0.25 more silicon in the mixture than is wanted in the castings. In the process outlined above the chances are that the silicon contents are none too high, as the metal is all made for Bessemerizing. The most serious matter, however, is the addition of iron ore. True, this reduces silicon and carbon, but unfortunately also adds oxygen to the bath, and the temperature is not that of a steel bath, where subsequent additions of ferromanganese remove the remaining oxides left over from an incomplete reaction. This point alone stamps "old contributor" as one unfamiliar with foundry metallurgy, no matter how sound his other arrangements are. From the mixing ladle other ladles take the metal and get any desired additions here before cooling off enough to pour (a rather expensive method). Direct metal is to go into molds for castings in which weight is more of an object than strength. Standard fly-wheels, gears, bed-plates, engine cylinders, etc., are supposed to be the product, and the work of 50 to 100 of the smaller foundries is to be absorbed. Result claimed is cheaper castings than the big works are able to make with present methods.

The Iron Trade Review draws some interesting deductions from the direct metal discussion, the points brought out being the following: Direct metal is used for castings with the lower range of silicon where the presence of the unavoidable slag admixtures causes no serious harm, hence in this respect the present method can be called up to date. How about the serious problem of "kish?" Will the structure of the casting be close enough practically, "all pig" going into it? How about scrap and sprues? The mechanical difficulties of handling such large bodies of metal successfully would be great, not to speak of the chemical constitution. Only that class of castings corresponding to Besse-

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mer iron would be cared for successfully. Making additions to iron in the ladle is always a difficult and costly matter. On the whole the efforts of large corporations to make their own stock, while sometimes cheapening it, is seldom productive of as good results as are obtained by the founder of specialties.

The Foundry of Dec., in discussing "old contributor," advises that the journal printing his thoughts take him out on some vacant lot and have him shot. While this radical proceeding may seem uncalled for, information is further given that the pipe business is looking for just such an opportunity, and in the manufacture of cast iron water pipe the plans outlined would find a speedy trial of their worth.

OIL MATCHES.

The Adams Co., of Dubuque, Iowa, contributes a memorandum on making oil matches which should be of interest to foundrymen. Where a match is to be kept indefinitely the following is recommended. First make your match frame of good lumber, using laps and screws. One inch is the proper depth for ordinary work. Any lugs or large projections can extend through the bottom board, which should be screwed on the frame after the match is rammed. The material used is one-half dry and new molding sand and one-half parting sand, boiled linseed oil, and litharge, the whole put through a No. 12 riddle. The finer the sand the more perfect the joint. A small handful of lithrage is enough for a 14"x14" match. The whole batch when all mixed should be of the consistency of well tempered molding sand. Small nails can be placed in the match close to the pattern, before dried, where injury is likely. When rammed up draw the pattern to see that the parting is good. Then return the pattern and let dry for a day or two, with a moderate amount of heat if possible. After the match is thoroughly dried the pattern should be removed and two coats of thin shellac applied.

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THIN BRASS CASTINGS.

American Machinist, Aug. 15. Mr. Chas. Vickers classifies as thin brass castings everything from one-half inch downward, The principal difficulties are scabbing or cutting, blowing, and squeezing down. In a large plate, for instance, scabbing is the chief cause of failure, and is usually the result of hard ramming or using the metal too hot. Use thin but broad gates, pour easy at first but then keep up the head of the runner full to the top. With work about 1-8" thick squeezing is the worst difficulty to contend with. The metal need not be too hot for this work, but when a casting is, say, 1-16" thick the metal must come from the furnace "boiling hot," and no time lost while skimming and pouring. Castings as thin as this seldom scab, but are easily squeezed or poured too cold. When small castings are cast in the same flask with heavier ones, the light pieces should be placed at the bottom end and in such a way that the metal has a direct way in. Name plates, for instance, are better placed squarely across the lower end of the mold, at the bottom of the main runner. The force of the metal is not checked in this way and the chances for a good casting are much increased.

THE FOUNDRY INDUSTRY OF SCOTLAND.

The Age of Steel. Mr. Benj. Taylor tells us that Robert Napier was one of the famous iron founders in Glasgow, and today the works are still building marine engines where the first ones were turned out in the early part of the nineteenth century. The Cunard Line was practically born in this foundry in 1840. Glasgow is noted for its pipe foundries, miles of it being produced without flaw or blemish. American stoves are now made there in large quantities as well as ornamental castings and sanitary work. The iron trade of Scotland is just 100 years old, for Robert Mushet discovered iron ore there in 1801. However, there was some smelting of pig iron done in 1750. The famous

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Carron Works, which made the well known "Carronades," were erected in 1760. In 1864 Scotch foundries consumed 200,000 tons of pig iron; in 1870 the figure was 298,000, and in 1900, 750,000 tons. It seems strange to say that American pig iron goes to the head center of the Scotch iron trade, but still stranger, that American pipe is now to be found there also.

MODERN CUPOLA PRACTICE.

Cassier's Magazine, May. Dr. Richard Moldenke discusses modern cupola practice in an illustrated magazine article. Attention is called to the pressing modern requirements, the necessity for heavy tonnages at comparatively low selling prices. Foundry economy is largely dependent upon the personal equation of the foundry owner. One man puts in a shell of iron with holes punched in it for tuyeres, another buys the best and most modern type he can find. The origin of the cupola is explained and the European adaptation of the shaft furnace for copper smelting to the uses of the iron foundry shown. The complete and economical burning of the fuel is the first point sought after in cupola design, next comes the form and then the method of running. As much economy may result from a careful watching of the daily practice, the foundry superintendent should furnish the foreman a daily memorandum of his results for his information and for possible betterment. While the requirements of a 300 ton pipe foundry are different from those of a small jobbing establishment, yet there are certain laws governing the design of cupolas that are applicable to all. The cross section should be round to reduce loss of heat and wear and tear. Very large diameters can use Mr. West's center blast to advantage. The cylindrical lining should be slightly contracted just above the tuyeres to prevent slag from bunging them up. Two rows of tuyeres are always advisable, the lower for melting as usual, and the upper to furnish additional air to insure complete combustion and thus get all the heat possible from the coke into the charge. Blast pressure should be 5 ounces and upward. Where production is to be forced, a positive blower is essential, and the pres-

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sure of the blast may be as high as 16 ounces. The distance from the bottom to the lower row of tuyeres should be no less than 14 inches; 18 to 20 inches is the best practice. As the coke bed above the tuyeres must be about two feet at all times, any distance between the bottom and the lower row of tuyeres greater than 20 inches increases the fuel bills. There is a compensation, however, in greater freedom from "bunging up;" in fact for continuous melting it is essential to have the space in question 3 feet or more instead of only half this amount. Charging doors are of late dropped nearly level with the floor, the best practice making it 6 inches above and a door on each side of the cupola. Electric hoists with a double counterbalanced cage system complete an ideal arrangement. After the old blast furnace type of cupola was abandoned, opportunity was given to design cupolas with sufficient tuyeres to force in a maximum of air at a minimum of pressure. The distinctive feature of European cupolas is the addition of a fore-hearth. "*Stahl und Eisen*" disputes this statement in a recent article, but the fact remains that to see cupolas with fore-hearths one must go to England and the Continent. It is rather strange that the advantages of the fore-hearth should not be recognized here, but doubtless the fear of cold iron is the reason for this. The article is concluded by a description of the best American and European cupolas. Eleven illustrations accompany the text.

CAST IRON CAR WHEELS.

The Iron Trade Review, May 16. Mr. William Fawcett writes about the present and future chilled cast iron car wheel. Railroad officials hardly realize the responsibility involved in the management of a modern car wheel factory. No material used in car construction has to pass through as severe a nordeal as the wheel. The following are the requirements made in a wheel specification recently issued by a prominent railroad. All wheels dated, arranged in groups under even date for inspection. Three blows with a 12 lb. sledge given to each wheel at three different

points on inside of flange between the brackets. No cracks or any visible foundry defects must be in evidence. Two wheels are selected from each lot of fifty or fraction thereof, from same date of casting. The tests made on these are as follows: The drop test. The wheel is placed flange down on an anvil block of not less than 1,700 lbs. Three supports not less than 5" wide are placed under the flange of the wheel. A weight of 140 lbs. dropping 12 feet strikes the wheel in the center. The striking face is flat and not less than 7" in diameter. The wheel must stand 12 blows without breaking in two or more pieces. Next comes the thermal test. The test wheel is laid face up in a bed of sand and a channel way 1 1-8" wide by four inches deep is molded up around it. The clean tread forms one side of this channel, and the flange the bottom. This channel is poured full of molten iron direct from the cupola spout, and poured in the same spot. After two minutes the wheel is examined, and if found broken or cracked through the tread the 50 wheels are rejected. All test wheels are now broken to examine depth of chill. The plate must break with a ragged fracture and be clean soft gray iron. The white portion must not exceed 7-8" in depth, nor be less than 5-8" in the middle of the tread. It must not be more than 3-4" or less than 1-2" in the throat. These tests can be met readily by the progressive wheel maker, but this does not guarantee that the life of the wheel will be satisfactory. While the wheel maker knows that he must use certain irons to insure long life, he is tied down to meet specifications, and he therefore works in that direction only, for he otherwise would sacrifice his product. Thus the limits between which a chill must be kept are too close, and as most inspectors are apt to be rather too critical, great losses result to the maker. If the railroad companies not only demand the above tests, but also require a life of six years, the wheel maker ought to be given some latitude in the preparation of his product. As a matter of fact six years guarantee on freight cars and two years for passenger service is required, and the wheel maker must replace every wheel which fails to have the life required or shows up any subsequent defect which causes expense to the railroad. Mr. Fawcett has carefully noted the quality of wheels made by various concerns as shown by the scrap he bought, and found that with the gradually

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increasing size and weight of the freight cars coming into use, a six years guarantee is very unwise. He also predicts that a better wheel will be required soon, and that this will be made of open hearth metal, or, in other words, furnace iron. A wheel that is to have a given chemical specification is hard to produce in the cupola and hence a radical change will be required in the car wheel foundry before long. A continuous melting, molding and pouring will be adopted for this contingency. Mr. Fawcett makes the plea that with a blast furnace arranged to make metal of a strictly uniform chemical composition the wheels resulting will be uniform, strong, of proper chill, and desirable in every way.

THE POSITION OF THE FOUNDRY INDUSTRY.

The Iron Trade Review, May 30. In an important editorial, published just before our last convention, Mr. Findley writes of the growing importance of the foundry industry. Special attention is called to the great influence of our Association for the good of the trade in so far as the study of foundry problems and their solutions renders the product to be more regular and valuable. The foundries of the country are aptly regarded as a good barometer of industrial conditions. The activity of the various industries of the country is quickly reflected in the size of the orders for special machinery. The foundry gets all these castings. In 1900 the new foundries built numbered 274, which brought the grand total up to 4,419. It is difficult to give actual tonnages of foundry irons consumed, the production of foundry and forge irons being 4,773,414 tons for 1900. The gray iron and malleable casting industries have lost little to steel, contrary to general expectations, but this is because of the attention which is now given the subject, the better understanding of the properties of cast iron having given this material a much higher standing in the manufacturing world. Nevertheless, it behooves us to keep right on with our work not only in turning out good product, but in raising the standard of the materials we buy. We

have to thank the *Iron Trade Review* for its earnest words of advice to the foundrymen of the country when it urges them to support our Association, as in so doing they are supporting themselves.

BETTERING THE WORK OF THE FOUNDRY.

Engineering Magazine. Mr. Percy Longmuir broadly sketches the opportunities existing at the present day in our daily foundry practice which, if taken advantage of properly, would result in great saving. The final cost is what counts, and all arrangements should be made to reduce this to the lowest figure possible. The metal should be the best possible for the purpose, the method of getting out the castings the cheapest possible consistent with a minimum amount of subsequent machining. One of the serious troubles in foundry improvement is the lack of system in the works. A molding machine may be bought, but the accessories for its most economical use are neglected, and it is often run only in a half hearted way. Mr. Longmuir now takes up the loses of the brass foundry with a view of studying economy therein. Intelligent melting may reduce the volatilization losses considerably, and efficient supervision is recommended. Careless skimming, pouring, spilling outside of the gate, overfilling the mold, etc., all tend to unnecessary losses. The metal thus spilled on account of the uncertainty in remelting is often classed with the "common scrap." This is bad economy. Careful picking over of the brass ashes is also good practice, as a lot of pieces of metal may be saved and the balance can be sold just the same. Even the brass turnings will pay to classify instead of lumping them together and casting ingots of unknown quality. The dross and skimmings of the white metal shop also represent a good opportunity for economy. Application of charcoal and soda ash at white heat brings out a lot of tin and copper mixed with a little antimony. Now in the iron foundry the opportunities lie in another direction. The metal itself is usually handled right, but its distribution leaves much to be

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desired. The facilities in a foundry are often only too limited. Cast iron flasks without planed joints, cast guide pins, etc., mean castings with overlapping joints and varying in weight and thickness. Snap flasks are usually good, but that is only because they are made outside. The cupola may be antediluvian, but so long as it is as cheap it has to "go," no matter if the melting ratio is very bad. What many foundries want is a good quick melting cupola, ample blower capacity, good charging platforms. The foundry well divided into floors, well equipped with the necessary tools. Serving these floors with iron quickly and in an economical way. Good flasks and ample storage room for them. Finally, a good management.

CUPOLA PRACTICE.

The Foundry, August. Mr. W. S. Scott continues his excellent articles on scientific founding, and in the present paper describes the cupola practice. In charging up the first thing done is to start a fire with a little kindling and about one-sixth cord of hard wood. When the fire is well started the coke bed of 1,800 lbs. goes on. When this is red hot, 400 lbs. more is thrown on, making the total bed 2,200 lbs. and bringing it 18" above the tuyeres. Now comes some scrap iron, then 3,000 lbs. pig iron, 300 lbs. steel rails, and then enough home and foreign scrap to make up the full charge of 6,000 lbs. Now come 450 lbs. coke, and then the second charge of 2,000 lbs. pig iron, 200 lbs. steel and 1,800 lbs. scrap, the successive charges then follow in regular order. Limestone goes on top of the sixth charge. All this for a cupola 62 inches inside the lining. About 12 tons of iron burdens the cupola up to the door. Blast is turned on by this time and the metal is tapped in 2,000 lb. lots.

MALLEABLE CAST IRON.

The Foundry, Sept. Mr. Chas. Powers discusses the development of the malleable casting. After stating that charcoal is the preferable iron for this purpose, with which we agree, he says that if there had been enough charcoal iron at hand, coke iron would never have been used in making "malleable," with which we do not agree, as coke malleable makes cheaper castings than charcoal, and, if handled right, equally as good. Then also coke iron bought on analysis is much more uniform than charcoal bought by grade. Mr. Powers gives a queer opinion in holding that the carbon in charcoal iron is different from that in coke, and is more easily reacted upon in the reverberatory furnace. This will be news to our metallurgists. The mechanically mixed carbon in iron is always graphite, whether in charcoal or coke irons. Silicon is rightly held to be the important impurity in iron, especially important in "malleable." Carbon must be kept low to insure strength and ductility. The white edge often found in poor malleable is not due to the action of sulphur on carbon, but rather the burning of the skin of the casting in anneal owing to a too open structure, this in turn the consequence of low silicon. Sulphur, as Mr. Powers says rightly, is not an element of strength or fluidity; on the other hand there are some excellent malleable castings with sulphur at .07 per cent. Regarding the presence of graphite in a casting, due to high silicon, there is no reconversion after anneal in this case, for the graphite found after anneal (this distinct from temper-carbon) was all there when the casting went into the oven. Mr. Powers' article is of interest, though the chemistry in it is a little hazy.

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BLAST FURNACE COMPARED WITH CUPOLA PRACTICE.

Mr. Edgar S. Cook, president of the Warwick Iron & Steel Co., Pottstown, Pa., recently read a very able and comprehensive paper on the above subject in connection with a discussion of machine cast iron for foundry use. We review briefly that portion which interests our foundrymen most. Mr. Cook urges the liberal use of scientific methods in the foundry as the best preventive of mistakes, and argues that the most successful blast furnace managers are those who, by daily contact with the problems of their calling, have mastered the practical details and then supplemented this training by technical studies. In the earlier days of the blast furnace everything was done by guess work also, and all the blame, if anything went wrong, was placed on the ore and the coke. With the present advancement of the furnace much knowledge was obtained on the influence of the impurities in iron, and this information was put at the disposal of the foundries. The advent of science in the foundry meant that the accident of fracture was put aside and compositions specified which gave exactly what was wanted, and often it was found that men knowing the composition of an iron offered as a No. 2 to be that of a No. 1, bought the metal just so much cheaper. The silicon and sulphur will usually be sufficient in using a given iron in a mixture. True, the manganese will flow off some of the sulphur, but it is expensive when paid for as iron and burned out. In furnace as well as cupola work a high temperature means a dissolution of iron and sulphur, the latter passing into the slag. Any stoppage or trouble which lowers the temperature of the furnace means an immediate union of the sulphur present with the iron. Similarly in the cupola, if the melt is cold the pig iron, if ever so low in sulphur, will absorb it from the coke very greedily. Hence the importance of good hot iron. Again in the blast furnace the first casts of iron were usually very uncertain, as the crucible below the tuyeres was cold and the iron underwent unknown changes before tapping. To remedy this difficulty the amount of fuel was increased in the first charge, which had the effect of heating up the crucible

properly and the resulting iron was all right. In the cupola similarly, too, the iron may reach the bottom before this is hot enough to keep the sulphur off, and being in contact with the coke it absorbs it readily. The atmospheric conditions are also important, water being blown in with the air. This is probably more important in the blast furnace than in the cupola. It may, however, mean bad heats where the coke is also wet from exposure to rain and snow. Mr. Cook now gives a very clear exposition of the fallacies met with in judging iron by fracture, and then recites the advantages of machine cast pig iron to the founder. To those of our founders who are interested in foundry progress, Mr. Cook will doubtless be glad to send a copy of his paper upon request, and they will find it replete with valuable information.

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